PB89-128375

Superfund Record of Decision (EPA Region 7)
Cherokee County/Galena, Kansas
December 1987. First Remedial Action

(U.S.) Environmental Protection Agency
Washington, DC

21 Dec 87

U.S. Department of Commerce
National Technical Information Service
NTIS

PB89-128375

United States
Environmental Protection
Agency

Office of
Emergency and
Remedial Response

EPA/ROD/R07-88/010
December 1987

EPA

Superfund Record of Decision:

Cherokee County/Galena, KS

REPRODUCED BY
U.S. DEPARTMENT OF COMMERCE
NATIONAL TECHNICAL INFORMATION SERVICE
SPRINGFIELD, VA. 22161

50272-101

REPORT DOCUMENTATION PAGE	1. REPORT NO. EPA/ROD/R07-88/010	2.	3. Recipient's Accession No. PB89 128375/AS
4. Title and Subtitle SUPERFUND RECORD OF DECISION Cherokee County/Galena, KS First Remedial Action			5. Report Date 12/21/87 6.
7. Author(s)			8. Performing Organization Rept. No.
9. Performing Organization Name and Address			10. Project/Task/Work Unit No. 11. Contract(C) or Grant(G) No. (C) (G)
12. Sponsoring Organization Name and Address U.S. Environmental Protection Agency 401 M Street, S.W. Washington, D.C. 20460			13. Type of Report & Period Covered 800/000 14.
15. Supplementary Notes			

16. Abstract (Limit: 200 words)

The Cherokee County site, the Kansas portion of the Tri-State Mining District, is located in the extreme southeastern corner of Kansas. The Galena subsite, one of six subsites identified within the Cherokee County site, encompasses 18 m^2. The Galena subsite is characterized by surface mining waste features that impact the quality of the shallow ground water aquifer. This aquifer is a primary source of drinking water for approximately 1,050 people. Remains from past mining activity at the subsite include: large areas covered by mine and mill wastes, water-filled subsidence craters, and open mine shafts. EPA investigations of the Galena subsite conducted in 1986 and 1987 demonstrated that the shallow ground water aquifer and surface water are contaminated with elevated concentrations of metals. Due to the concern for the health of persons drinking this water, EPA Region VII conducted a removal action and installed water treatment units on these wells, This removal action was considered a temporary protective measure. The primary contaminants of concern observed in the private wells include: cadmium, lead, selenium, and zinc.

The selected remedial action for this site provides for collection of water from the aquifer through existing wells owned by the City of Galena with subsequent distribution of that water through a pipeline network to 418 houses, businesses, and farms outside of (See Attached Sheet)

17. Document Analysis a. Descriptors

Record of Decision
Cherokee County/Galena, KS
First Remedial Action
Contaminated Media: gw
Key Contaminants: metals (cadmium, lead, selenium, zinc)

b. Identifiers/Open-Ended Terms

c. COSATI Field/Group

18. Availability Statement	19. Security Class (This Report) None	21. No. of Pages 42
	20. Security Class (This Page) None	22. Price PC 13.95/MF 6.95

(See ANSI-Z39.18) See Instructions on Reverse

OPTIONAL FORM 272 (4-77)
(Formerly NTIS-35)
Department of Commerce

EPA/ROD/R07-88/010
Cherokee County/Galena, KS
First Remedial Action

16. ABSTRACT (continued)

the Galena municipal water system but within the subsite. Additional capacity for the expanded system will be rehabilitated to provide additional capacity for the expanded system. If rehabilition becomes infeasible due to unforeseen onsite technicalities, a new deep aquifer well may be drilled to provide additional waters. The remedy includes acquiring the construction and equipment necessary to setup a water supply to this area. The estimated present worth cost for this remedy is $5,300,000 with annual O&M of $100,000.

RECORD OF DECISION
OPERABLE UNIT REMEDIAL ALTERNATIVE SELECTION

SITE NAME

Cherokee County Site - Galena Subsite
Cherokee County, Kansas

STATEMENT OF PURPOSE

This decision document represents the selected remedial action for the alternative water supply operable unit developed in accordance with the Comprehensive Environmental Response, Compensation and Liability Act of 1980 (CERCLA), as amended by the Superfund Amendments and Reauthorization Act of 1986 (SARA), and to the extent practicable, the National Contingency Plan (NCP).

The State of Kansas has concurred on the selected remedy.

STATEMENT OF BASIS

This decision is based upon the administrative record. The attached index identifies the items which comprise the administrative record.

DESCRIPTION OF THE SELECTED REMEDY

The Galena subsite is one of six subsites within the Cherokee County site. It has been divided into two operable units: alternative water supply and ground water/surface remediation. This decision document addresses the alternative water supply. The second decision document is expected to be completed in the second quarter of FY-88.

The selected remedy provides for collection of water from the Roubidoux aquifer through existing wells owned by the City of Galena and the distribution of that water through a pipeline network to the houses, businesses and farms within the subsite, but outside of the Galena municipal water system. The two wells will need to be rehabilitated in order to provide the necessary water. A new well will need to be drilled if the existing wells cannot be rehabilitated. The remedy includes the construction and equipment necessary to set-up a water supply to this area.

DECLARATIONS

Consistent with the Comprehensive Environmental Response, Compensation and Liability Act of 1980, as amended, I have determined that the provision of an alternative water supply to the residents of the Galena subsite of the Cherokee County site, whose primary source of drinking water is the contaminated shallow aquifer, is a cost-effective remedy, consistent with permanent remedial action for the site and provides adequate protection of public health, welfare and the environment. The remedy selection procedure and the selected remedial action comply with the provisions of the Superfund Amendments and Reauthorization Act of 1986. The selected remedy is not inconsistent with the National Contingency Plan, 40 CFR §300, and is a component of a total remedial action for the site. The State of Kansas has been consulted and concurs with the selected remedy.

12-21-87
Date

Regional Administrator

ROD DECISION SUMMARY

CHEROKEE COUNTY SITE

CONTENTS

	PAGE
Introduction	1
Site Location and Description	1
Site History	2
Enforcement	4
Community Relations History	6
Development of Alternatives	6
Remediation goals	7
Initial screening	7
Detailed analysis of alternatives	15
Selected Remedy	23
General description	23
Scope and function of operable unit	24
Performance Goals	26
Rationale for preference	26

LIST OF FIGURES

FIGURE		PAGE
1.	Galena Subsite Map	3
2.	Selected Alternative Diagram	25

LIST OF TABLES

TABLE		PAGE
1.	Concentrations of Total Metals Observed in Private Wells	5
2.	Response Action and Technology List and Screening	8
3.	Preliminary Alternatives Screening	12
4.	Detailed Evaluation of Alternatives	17
5.	ARARs for Selected Alternative	27

ROD DECISION SUMMARY
CHEROKEE COUNTY SITE - GALENA SUBSITE
CHEROKEE COUNTY, KANSAS

INTRODUCTION

The purpose of this document is to describe the remedy that the U.S. Environmental Protection Agency (EPA) has selected to implement at the Galena subsite of the Cherokee County site. This document also describes the decision-making procedures that were followed in selecting this remedial action, which provides an alternative water supply for residents living within the subsite.

The remedial action has been selected to remedy an environmental problem potentially affecting the health of residents living within the subsite. This action is one part of an entire response action for remedying an uncontrolled site containing hazardous substances. As it is only part of the whole action, this is referred to as an "operable unit" remedial action. Operable units must be consistent with the final remedy for a site and must be cost-effective according to the Superfund Amendments and Reauthorization Act of 1986 (SARA). This action is consistent and cost-effective with the site-wide remedy.

The decision-making processes regarding the Cherokee County site began with preliminary investigations, which led to the inclusion of the site on the National Priorities List (NPL) for cleanup of releases or threatened releases of hazardous substances. The site was separated into six subsites for further investigation and eventual cleanup.

A remedial investigation (RI) and an operable unit feasibility study (OUFS) conducted at the Galena subsite led to the conclusion that the shallow ground water aquifer contains levels of metals above primary maximum contaminant levels (MCLs) established by the Safe Drinking Water Act. Approximately 1,050 people who live within the Galena subsite use this contaminated shallow aquifer for their sole source of drinking water. The decision to provide these people with an alternative drinking water supply is based on the known release of hazardous substances into the shallow ground water aquifer, which is primarily the result of prior mining activities conducted at the subsite and degradation of the mining wastes over the past 100 years. The following discussions explain procedures EPA used in making this Record of Decision (ROD).

SITE LOCATION AND DESCRIPTION

The Cherokee County site is the Kansas portion of the Tri-State Mining District, which includes the lead and zinc mining area in Jasper County, Missouri, Cherokee County, Kansas and Ottawa County, Oklahoma. Cherokee County is located in the extreme southeastern corner of Kansas.

The Galena subsite is one of six subsites identified within the Cherokee County site. The Galena subsite encompasses 18 square miles and includes the communities of Galena, Lowell and surrounding homes, farms

and businesses (Figure 1). Approximately 1,050 people live outside the City of Galena. These residents obtain drinking water from private shallow aquifer wells ranging from 20 to 200 feet in depth. People within the City of Galena receive drinking water from the Galena public water supply system, which provides good quality water from a deep aquifer, approximately 1,000 to 1,200 feet in depth.

The Galena subsite is characterized by surface mine waste features that impact the quality of the shallow ground water aquifer. The most significant mine waste area is referred to as "Hell's Half Acre," which contains sparse to no vegetation and is totally covered with surface mine wastes. The mined areas contain over 350 open shafts and collapses which are direct conduits to the shallow ground water. Short Creek flows through Hell's Half Acre. Other creeks in the area are Shoal Creek and Owl Branch. Short and Shoal Creeks empty into the Spring River, which also flows through the subsite.

SITE HISTORY

Ore was first discovered in the Tri-State Mining District in 1848. The first economically significant mine in Kansas was in the City of Galena, where ore was discovered in 1876. Sphalerite (zinc sulfide) and galena (lead sulfide) were the important commercial ore minerals. Pyrite and marcasite (both iron disulfide) were commonly found in association with the lead and zinc minerals. The district was an important source of cadmium, which was produced as a by-product of the lead-zinc smelting process. A smelter was built along Short Creek in the 1890's. The area near the original smelter was used for various smelting facilities until around 1961, then the remaining facility was converted to produce sulfuric acid.

Ore deposits in the Galena vicinity occur in veins and are typically 80 to 100 feet deep. This shallow depth allowed numerous small mining operations to prosper. Exploration and mine development were accomplished by excavating vertical shafts to locate the ore body. Mining progressed outward from the vertical shafts using a modified room and pillar method to follow the ore vein. The use of vertical shafts as a means of mineral exploration and the subdivision of leases into small subleased mining plots result in a high density of mine shafts in the subsite. Over 350 open shafts are readily accessible in and around the City of Galena. Several mines have collapsed, forming subsidences of varying sizes and shapes. Many circular subsidences are less than 75 feet in diameter while others, from circular to rectangular, measure several hundred feet along the longest dimension. A ground level difference of 20 to 40 feet is common in the subsidences within the subsite. Some subsidences are filled with water and may be deeper.

The most obvious remains of the intense mining activity at the subsite are large areas covered by mine and mill wastes, water-filled subsidence craters and open mine shafts. The localized term "chat" describes the waste piles of gravel-sized rock, which resulted from the early ore milling process.

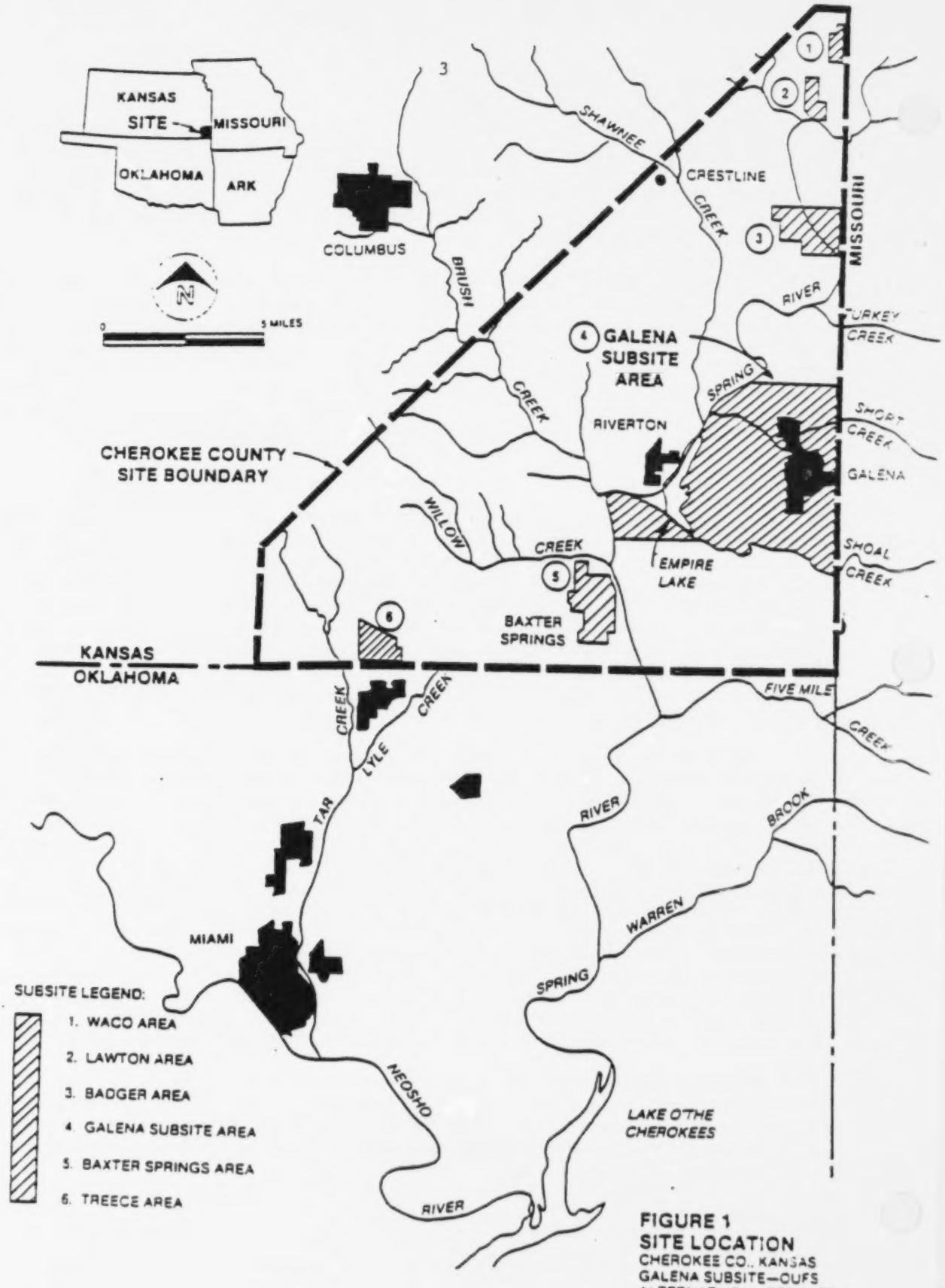

FIGURE 1
SITE LOCATION
CHEROKEE CO., KANSAS
GALENA SUBSITE—OUFS
ALTERNATIVE WATER SUPPLY

Large chunks of unmilled waste rock derived from the excavation of vertical shafts have been termed "bullrock." Little to no vegetation is found on chat-covered areas. Although a very large portion of the subsite is covered by these chat and bullrock piles, it has been impractical to measure or estimate the quantity of this material at the site.

The EPA began its investigation of the Galena subsite in 1985. A Phase I remedial investigation was completed in 1986. This investigation examined the impacts of the mining activities on the ground water, surface water, ambient air, soils, stream sediments and fish. At the result of this work, EPA determined additional information on the ground water and surface water was necessary in order to evaluate potential remedial actions. These additional investigations were conducted in 1986 and 1987.

The subsite investigations demonstrated that the shallow ground water aquifer and the surface water are contaminated with elevated concentrations of metals. The private shallow aquifer wells that were found to be contaminated have been of great concern. Many of these private wells are contaminated with metals that exceed the primary and secondary maximum contaminant levels established by the Safe Drinking Water Act. Due to the concern for the health of persons drinking this contaminated water, EPA, Region VII conducted a removal action and installed water treatment units on these wells with permission of the property owners. This removal action has been considered a temporary protective measure.

Table 1 lists the average and maximum levels of metals observed in private wells in the subsite and the drinking water standards. The metals of most concern for human health are cadmium, lead, selenium and zinc. The kidney is the critical target organ in humans chronically exposed to cadmium by ingestion. Exposure to lead can cause severe neurotopic effects that include irreversible brain damage. Selenium ingestion causes depression, gastrointestinal disturbances and occasional dermatitis. Excessive levels of zinc can cause stomach disorders. Exposure to cadmium can cause changes in the distribution of zinc, with increases in the liver and kidneys.

ENFORCEMENT

General notice letters were issued to inform potentially responsible parties (PRPs) of their potential liabilities for past activities at the Cherokee County site. Nine mining or former mining companies were notified in 1985. Two additional companies were notified of potential responsibility in 1986. The original nine companies received notification prior to the removal action and

TABLE 1
CONCENTRATIONS OF TOTAL METALS
OBSERVED IN PRIVATE WELLS

Metals	Average Observed Value (ug/l)[a]	Maximum Observed Value (ug/l)	Standard or Criteria (ug/l)
Barium	79	390	1,000b
Cadmium	7.8	180	10b
Chromium (total)	95	95	50b
Copper	23	940	1,000c
Lead	28	230	50bd
Manganese	100	3,400	50c
Mercury	0.059	0.44	2b
Nickel	23	190	150e
Selenium	28	50	10b
Silver	7.3	11	50b
Zinc	980	15,000	5,000c

a = Micrograms per liter
b = Primary MCL, Safe Drinking Water Act
c = Secondary MCL, Safe Drinking Water Act
d = The proposed MCLG (Safe Drinking Water Act) is 20 ug/l
e = Lifetime Health Advisory (EPA, Office of Drinking Water)

prior to the remedial investigation. All eleven companies indicated no desire to participate in the remedial investigation or any additional investigations or the Operable Unit Feasibility Study. The EPA conducts periodic meetings with these PRPs to facilitate information sharing.

Special notice letters to initiate formal negotiations with these eleven companies regarding the Remedial Design/Remedial Action (RD/RA) for the alternative water supply operable unit are scheduled for issuance in early 1988. In addition, the special notices will initiate negotiation regarding the RD/RA of the second operable unit for the subsite on ground water and surface water cleanup.

COMMUNITY RELATIONS HISTORY

Community and Congressional interest regarding EPA's activities at the site have been high. A public meeting was held in July 1985 prior to the beginning of the RI/FS. Another public meeting was held in May 1986 at the conclusion of the remedial investigation and prior to the removal action. At the conclusion of the OUFS for the alternative water supply, another public meeting was held in November 1987.

All public meetings were held in the Galena subsite. The latter public meeting coincided with a 37-day public comment period. A responsiveness summary of public comments regarding the alternative water supply OUFS is attached to this Record of Decision. Information regarding EPA's activities at the site has been available at the Galena Public Library in the form of the information repository and administrative record. All community relations activities have been in conformance with the requirements of Section 117, CERCLA, as amended by SARA, and the National Contingency Plan (NCP) in 40 CFR §300.

A group of legislators formed a task force to help assist coordination of activities at the Cherokee County site. The task force is made up of 22 people, including the Lieutenant Governor, four State Senators and Representatives, a U.S. Representative and people representing the City of Galena, Cherokee County, Kansas National Guard, Kansas Department of Health and Environment, Kansas Mined Lands Conservation and Reclamation Board, Kansas Water Office, U.S. Bureau of Mines, U.S. Office of Surface Mining, U.S. Soil Conservation Service, EPA and citizens.

DEVELOPMENT OF ALTERNATIVES

The remedial alternatives for the Alternative Water Supply Operable Unit were developed and evaluated in compliance with the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA), as amended by the Superfund Amendments and Reauthorization Act of 1986 (SARA), 42 U.S.C. §9601 et seq., and the National Oil and Hazardous Substance Pollution Contingency Plan, 40 CFR Part 300 (NCP). Section 121(b) of CERCLA provides that a remedy shall be selected that is protective of human health and the environment, that is cost-effective and that utilizes permanent solutions and alternative treatment technologies or resource recovery technologies to the maximum extent practicable. The OUFS for the alternative water supply evaluated alternatives in light of the requirements of Section 121 of CERCLA.

Remediation Goals

The primary goal of the operable unit remediation is to provide suitable drinking water to the population within the subsite. Suitable drinking water is water that meets the primary maximum contaminant levels (MCLs), 40 CFR §141, as set by the Safe Drinking Water Act, 42 USC §1412 at existing water taps. In addition, Kansas Safe Drinking Water Standards, KAR 23-15-1 through -10 should be met to provide safe and suitable drinking water. A second indirect, but equally important goal, is to protect the deep aquifer from contamination that could occur as a direct or indirect result of implementing an alternative water supply. These goals are compatible with overall site-wide and subsite remediation goals.

Initial Screening

Several general response actions and technologies were evaluated for collecting, treating and distributing an alternative water supply. All alternatives were evaluated based on their ability to achieve remediation goals. Screening of the response actions and technologies as required by 40 CFR §300.68(g) was conducted to eliminate alternatives that: 1) Did not effectively protect public health, welfare and the environment, 2) Were not feasible or reliable for the site and 3) Did not provide substantially greater protection, but were of greater costs. Table 2 lists the response actions and technologies that were reviewed and specifies reasons for the elimination of various technologies. The OUFS may be reviewed for details on the screening process.

Various technologies to implement a reliable, good quality water supply for the population were reviewed. Sources of water considered included: 1) Deep aquifer, 2) Shallow aquifer, 3) Surface water and 4) Imported water. Imported water technologies included tank truck delivery and bottled water delivery. Surface water and shallow aquifer sources required biological, chemical and physical treatment technologies and a pipeline distribution system for delivery. The deep aquifer source required only chlorination and a pipeline system for delivery.

Remedial alternatives were developed utilizing the available technologies after the initial technology screening. These preliminary alternatives were screened using the same methodology employed in the technology screening, eliminating alternatives that: 1) Did not effectively protect public health, welfare and the environment, 2) Were not feasible or reliable for the site and 3) Did not provide substantially greater protection, but were of greater costs. Table 3 lists these preliminary remedial alternatives and specifies reasons for the elimination of various alternatives. The OUFS may be reviewed for details on the screening process.

Table 2
RESPONSE ACTION AND TECHNOLOGY LIST AND SCREENING

General Response	Response Actions	Potential Technologies	Technical Options	Comments	Retained for Further Analysis
1. No Action	No Action	Not Applicable	--	No action alternative.	Yes
2. Treatment at Individual Well	Treatment	Biological	--	Not applicable for treatment of shallow groundwater with metals contamination.	No
		Chemical	Chlorination	Disinfection not required for individual systems.	No
			Precipitation	Not practical for small systems.	No
		Physical	Filtration	Possible pretreatment prior to RO.	Yes
			Reverse Osmosis	Marginally suitable for private wells.	Yes
			Ion Exchange	Effective for metals removal.	Yes
			Manganese Greensand Filtration	May be required for iron and manganese removal.	Yes
			Carbon Adsorption	Not as effective as other methods for metals removal.	No
			Water Softening	Suitable for residences but not well proven for metals removal.	
			Distillation	Very expensive, but retain for waste volume reduction.	Yes
			Boiling	Not practical for metal removal due to high costs and energy requirements.	Yes
	Byproduct Disposal	Landfill	RCRA Type	May be required for some wastes from treatment process.	No
			Solids Landfill	May be acceptable for some wastes from treatment process.	Yes
		Land Application	--	May be acceptable for some wastes from treatment process.	Yes
		Byproduct Reuse	Cost Recovery	Not economical for small quantities.	Yes
3. Import Potable Water Supply	Alternate Supply	Distribution System	Bottled Water Delivery	Provides only drinking and food preparation water.	No
			Tank Truck Delivery	Provides only in-house water uses.	Yes
4. Develop and Distribute Existing or New Deep Aquifer Supply (Roubidoux)	Collection	Deep Wells	Connect to Galena system	Closest existing source.	Yes
			Connect to other water districts	Generally farther away and inadequate capacity.	No
			New System	Feasible.	Yes
	Treatment	Biological	--	Not needed.	No
		Chemical	Chlorination	Used for disinfection.	Yes
			Others	Not needed.	No
		Physical	--	Not needed.	No
	Distribution	Pipeline System	Pumped pressure system	Conventional water distribution system.	Yes
		Storage	Elevated Tanks	--	Yes
			Reservoirs	--	Yes

Table 2
(continued)

General Response	Response Actions	Potential Technologies	Technical Options	Comments	Retained for Further Analysis
5. Develop, Treat, and Distribute Shallow Aquifer Supply	Collection	Shallow Wells	--	Location selection is important to ensure adequate supply.	Yes
	Treatment	Biological	--	Not applicable for treatment of water that does not have high organic contamination.	No
		Chemical	Chlorination	Used for disinfection.	Yes
			Precipitation	Effective for removing soluble heavy metals.	Yes
			Neutralization	May be required to adjust pH.	Yes
			Aeration/Oxidation	Used for iron removal.	Yes
			Hydrolysis	Not well suited for water treatment.	No
			Dechlorination	Not required.	No
			Ozonation	High cost, eliminated in favor of chlorination for disinfection.	No
			Ultraviolet Radiation	Deleted in favor of chlorination for disinfection.	No
			Photolysis	Not suited for water treatment.	No
		Physical	Ion Exchange	Effective for metals removal.	Yes
			Lime Softening	May not reduce metals to required levels, but retain for further analysis. Consider using with soda ash.	Yes
			Coagulation/Flocculation	May be required as a pretreatment.	Yes
			Sedimentation	An important process in precipitation of heavy metals.	Yes
			Filtration	An important process in precipitation of heavy metals.	Yes
			Oil-Water Separation	Not required for groundwater treatment.	No
			Carbon Adsorption	Not as effective as other methods for metal removal.	No
			Mn Greensand Filtration	May be used for Fe and Mn removal.	Yes
			Membrane processes		
			Reverse Osmosis	Depends on pretreatment requirements.	Yes
			Ultrafiltration	Not as effective as RO.	No
			Dialysis	Feasible, but more expensive than RO.	No
			Electrodialysis	Feasible, but more expensive than RO.	No
			Air and Steam Stripping	Used for VOC removal. Not suited for metal removal.	No
			Flotation	Not suited for metals removal.	No
			Distillation Processes	Very expensive compared to membrane processes but retain as possible means of waste volume reduction.	Yes
	Byproduct Disposal	Landfill	RCRA Type	May be required for some wastes from water treatment processes.	Yes
			Solids Landfill	May be acceptable for some wastes from water treatment processes.	Yes
		Land Application	--	May be acceptable for some wastes from water treatment processes.	Yes
		Byproduct Reuse	Cost Recovery	Not economically feasible for small quantities.	No
	Distribution	Pipeline System	Pumped pressure system	Conventional water distribution system	Yes
		Storage	Elevated Tanks	--	Yes
			Reservoirs	--	Yes

Table 2
(continued)

General Response	Response Actions	Potential Technologies	Technical Options	Comments	Retained for Further Analysis
6. Develop, Treat, and Distribute Existing or New Surface Water Supply	Collection	Stream Intake	Connect to City of Baxter Springs	Requires expansion of water treatment plant.	Yes
			Spring River Location	Reliable source with suitable quality.	Yes
			Shoal Creek Location	Somewhat less reliable source and quality.	Yes
			Short Creek Location	Insufficient flow and degraded quality.	No
			Empire Lake Location	Degraded water quality due to Short Creek discharges and limited circulation.	No
		Raw water storage	Reservoir	May be required for smaller water sources.	Yes
		Channelization	--	Not necessary to collect water, better option is to collect from existing streams or impoundments.	No
	Treatment	Biological	--	Not required.	No
		Chemical	Chlorination	Used for disinfection.	Yes
			Precipitation	Effective for removing soluble heavy metals.	Yes
			Neutralization	Not required.	No
			Aeration Oxidation	Used for iron removal.	Yes
			Hydrolysis	Not well suited for water treatment.	No
			Dechlorination	Not required.	No
			Ozonation	High cost and complex, delete in favor of chlorination for disinfection.	No
			Ultraviolet Radiation	Deleted in favor of chlorination for disinfection.	No
		Physical	Photolysis	Not well suited for water treatment.	No
			Ion Exchange	May be required if metal levels are high.	Yes
			Lime Softening	May not reduce metals to required levels, but retain for further evaluation. Consider using with soda ash.	
			Coagulation/Flocculation	Effective process for reducing surface water turbidity.	Yes
			Sedimentation	Effective process for reducing surface water turbidity.	Yes
			Filtration	Effective process for reducing surface water turbidity.	Yes
			Oil-Water Separation	Not required for local water sources.	No
			Carbon Adsorption	May be required to remove THM's if present.	Yes
			Molecular Sieves	Better treatment processes are available.	Yes
			Manganese Greensand Filtration	Use only if Fe and Mn are problems.	Yes
			Membrane Processes		
			Reverse Osmosis	Needed only if metal levels are high.	Yes
			Ultrafiltration	Needed only if metal levels are high.	Yes
			Dialysis	Needed only if metal levels are high.	Yes
			Electrodialysis	Needed only if metal levels are high.	Yes
			Air and Steam Stripping	Not required for metals treatment.	No
			Flotation	Not required for metals treatment.	No
			Distillation	Very expensive and not required for treatment.	No

Table 2
(continued)

General Response	Response Actions	Potential Technologies	Technical Options	Comments	Retained for Further Analysis
6. Develop, Treat, and Distribute Surface Water Supply (continued)	Byproduct Disposal	Landfill	RCRA Type	May be required for some wastes from water treatment processes.	Yes
			Solids Landfill	May be acceptable for some wastes from water treatment processes.	Yes
		Land Application	--	May be acceptable for some wastes from water treatment processes.	Yes
		Byproduct Reuse	Cost recovery	Not economically feasible for the small quantities.	No
	Distribution	Pipeline System	Pumped Pressure System	Conventional water distribution system.	Yes
		Storage	Elevated Tanks	--	Yes
			Reservoirs	--	Yes

Table 3
PRELIMINARY ALTERNATIVE SCREENING

General Response	Preliminary Alternative	Effectiveness	Implementability	Preliminary Cost Estimates: Initial Capital	Preliminary Cost Estimates: Annual Operation and Maintenance	Screening
1. No Action	No Action	Not applicable	Not applicable	--	--	Retain. No action alternative is retained for detailed evaluation to provide comparison.
2. Treat at Individual Wells	Treat at individual wells	Achieves Goal of providing safe water supply if treatment systems are well maintained. Requires potentially hazardous waste byproduct disposal.	Poor. Requires installation of many treatment units. Poor control of maintenance and waste by-product disposal.	$2,000,000	$300,000	Delete. Poor maintenance (effectiveness) control.
3. Import Water Supply	Bottled water delivery	Provides safe water for drinking and food preparation, but provides very limited level of water service. Existing shallow wells required for remainder of water uses.	Good. Requires vendor or agency to establish and operate bottle distribution system. Very flexible.	300,000	200,000	Retain. Attains specific goals at lowest initial cost.
	Tank truck delivery	Provides safe water for household uses but provides limited level of water service. Existing shallow wells required for watering lawns, washing cars, etc.	Good. Requires vendor or agency to establish and operate tank truck delivery system. Requires placement of storage tanks on every water users property.	1,200,000	300,000	Delete. Attains same basic goals as bottled water delivery, but is much more costly.
4. Deep Aquifer Supply	City of Galena, deep wells	Achieves goal of providing safe water supply. Protection of deep aquifer water quality requires further evaluation.	Good. Requires management by rural water district or City of Galena and cooperation with City of Galena for use of existing wells.	3,200,000	100,000	Retain. Good implementability if it is feasible to expand distribution system and rehabilitate existing wells.
	New rural water district deep well	Achieves goal of providing safe water supply. Protection of deep aquifer water quality requires further evaluation.	Good. Requires rural water district.	3,300,000	100,000	Retain. Similar to above alternative.
5. Shallow Aquifer Supply	Shallow aquifer well in "Hulls Half-Acre," ion exchange treatment	Poor groundwater quality may require secondary treatment to meet APAR's. Requires potentially hazardous waste byproduct disposal.	Good. Requires rural water district and cooperation with City of Galena in locating treatment plant and distribution system.	4,600,000	350,000	Delete. Capital cost is slightly higher than for locating shallow wells in the area west of Galena. Poorer quality source water. Annual costs higher than for lime softening treatment due to regenerate waste disposal requirements.

Table 3
(continued)

General Response	Preliminary Alternative	Effectiveness	Implementability	Preliminary Cost Estimates: Initial Capital	Preliminary Cost Estimates: Annual Operation and Maintenance	Screening
5. (cont'd)	Shallow-aquifer well in "Hells Half-Acre," lime softening treatment	Poor groundwater quality may require secondary treatment to meet ARAR's. Requires potentially hazardous waste product disposal.	Good. Requires rural water district and cooperation with City of Galena in locating treatment plant and distribution system.	$4,600,000	$250,000	Delete. Capital cost is slightly higher than for locating wells in the area west of Galena. Poorer quality water source.
	Shallow aquifer well west of Galena, ion exchange treatment	Poor groundwater quality may require secondary treatment to meet ARAR's. Requires potentially hazardous waste byproduct disposal.	Good. Requires rural water district and cooperation with City of Galena in locating treatment plant.	4,400,000	350,000	Delete. Ion exchange waste disposal more costly than lime softening.
	Shallow aquifer well west of Galena, lime softening treatment	Poor groundwater quality may require secondary treatment to meet ARAR's. Requires potentially hazardous waste byproduct disposal.	Good. Requires rural water district and cooperation with City of Galena in locating treatment plant.	4,400,000	250,000	Retain. Slightly lower capital cost than for locating wells in "Hell's Half Acre." Lower annual costs than for ion exchange treatment. Retain for evaluation of one shallow aquifer alternative. Better quality water source.
6. Surface Water Supply	Shoal Creek intake	Should normally achieve goal of providing safe water. Some concern for potential discharge of poorly treated sewage effluents upstream of intake combined with small dilution capability of Shoal Creek. Requires waste byproduct disposal.	Good. Requires rural water district. Diversions during low flow may adversely impact fish or wildlife. Some concern over adequacy of water supply. Technology readily available and feasible.	4,900,000	250,000	Delete. Greater problems with water quality, water supply and impacts on biota than in using Spring River.
	Spring River intake	Achieves goal of providing safe water supply. Requires waste byproduct disposal.	Good. Requires rural water district. Technology readily available and feasible.	5,100,000	250,000	Retain. Most reliable quantity and quality of the surface water sources considered.

Table 3
(continued)

General Response	Preliminary Alternative	Effectiveness	Implementability	Preliminary Cost Estimates		Screening
				Initial Capital	Annual Operation and Maintenance	
6. (cont'd)	City of Baxter Springs, Spring River and deep wells	Achieves goal of providing safe water supply. Some concern for effects of Short Creek metals discharge into Spring River. Protection of deep aquifer water quality requires further evaluation if deep well resource is used. Requires waste byproduct disposal.	Fair. Requires rural water district and cooperation with City of Baxter Springs. Requires expansion of treatment plant (river water) or new well. Requires river crossing for transmission pipeline.	$5,500,000	$250,000	Delete because source is relatively remote from service area and because the City is currently having groundwater and surface water quality problems. More costly than other surface sources.

Detailed Analysis of Alternatives

The initial screening of preliminary alternatives and response technologies provided the basis for selecting alternatives for detailed analysis. The six remaining alternatives have been fully discussed in the OUFS Report. A brief explanation of each alternative follows:

° Alternative 1: No Action

No action would be taken to improve the water supply to the residents. It is assumed that the residents would continue to use the existing shallow wells as the primary source of water and that no treatment would be provided. Periodic monitoring was considered as a back-up to the no-action alternative.

° Alternative 2: Bottled Water

This alternative would provide water only for drinking and food preparation. Water for all other uses such bathing, washing clothes and dishes, toilet flushing, cleaning and lawn and garden irrigation would be provided by existing shallow wells.

° Alternative 3: City of Galena, Deep Wells

Water would be collected from the City of Galena deep aquifer wells, chlorinated and distributed to the residents via a water pipeline network. The water collection and treatment would be maintained by the City of Galena. The distribution of the water past the city boundaries would be managed by the City of Galena, an existing rural water district or a new rural water district.

° Alternative 4: Rural Water District Deep Well

The alternative water would be collected from a deep aquifer well to be constructed west of the City of Galena. The water would be chlorinated and distributed by a water pipeline network to the residents. The entire system would be managed by an existing rural water district, a new rural water district or the City of Galena.

° Alternative 5: Shallow Aquifer Well

The alternative water would be collected from a shallow aquifer well to be constructed within the City of Galena. The water would be treated to remove the heavy metals in a newly constructed water treatment plant. After treatment, the water would be distributed by a water pipeline network to the residents. The system would be managed by the City of Galena, a new rural water district or an existing rural water district.

° Alternative 6: Spring River

The alternative water would be collected from a surface water intake on the Spring River to be constructed north of Short Creek. The water would be treated in a newly constructed water treatment plant located near the intake. After treatment, the water would be distributed by a water pipeline network to the residents. The system would be managed by the City of Galena, a new rural water district or an existing rural water district.

As required by 40 CFR §300.68(h), EPA conducted a detailed analysis of each of the six remedial alternatives. The analysis included: 1) Refinement of the feasibility of the alternative, 2) Detailed cost estimation, including operation and maintenance costs and distribution of cost overtime, 3) Evaluation in terms of engineering, implementation, reliability and constructability, 4) An assessment of the extent to which the alternative effectively prevents, mitigates or minimizes threats to and provides adequate protection of public health and welfare and the environment, 5) An evaluation of the extent to which the alternative attains or exceeds applicable or relevant and appropriate federal public health and environmental requirements, and 6) An analyses of any adverse environmental impacts. Analyses of recycle/reuse waste minimization, waste biodegradation, or destruction or other advanced, innovative or alternative technologies were not reviewed. These later analyses will be made in the ground water/surface water OUFS. For a detailed description of the analyses conducted, refer to the OUFS Report.

The six alternatives considered in the detailed evaluation were compared to CERCLA criteria for selection of remedy as defined in Section 121 of CERCLA and EPA OSWER Directives 9355.0-19 and 9355.0-20. These remedy selection criteria include: 1) Compliance with applicable and relevant or appropriate state and federal regulations (ARARs), 2) Reduction of mobility, toxicity or volume of waste, 3) Short-term effectiveness, 4) Long-term effectiveness, 5) Permanence, 6) Implementability, 7) Cost and 8) Community and state acceptance. The detailed analyses of each alternative are summarized in the following sections and on Table 4. More detailed information is located in the OUFS Report.

Compliance With ARARs

Section 121(d), Degree of Cleanup, CERCLA, as amended by SARA, requires that remedial actions shall attain a degree of cleanup of hazardous substances released into the environment and a degree of control over further release that at a minimum assures protection of human health and the environment. This section elaborates on cleanup standards to be employed with respect to any hazardous substance or contaminant that will remain onsite. It requires that any Federal or State criteria or standard which are legally applicable to the hazardous substance or are relevant and appropriate under the circumstances shall be the level or standard of control for such hazardous substance or contaminant remaining at the site. Certain Federal or State standards have been determined to be legally applicable or relevant and appropriate requirements (ARARs)

TABLE 4 - DETAILED EVALUATION OF ALTERNATIVES

Alternative	Compliance With ARARs	Reduction of Mobility, Toxicity or Volume of Waste	Short-Term Effectiveness (Construction)	Long-Term Effectiveness
1. No Action	Does not meet ARARs for drinking water supplies.	No reduction of mobility, toxicity or volume.	Risks to public health and environment remain at current levels.	Risks to public health remain at current levels. Risks may decrease over geologic time due to natural degradation.
2. Bottled Water	Can be designed to meet ARARs.	No reduction of mobility, toxicity or volume.	No construction, therefore, no additional risk to community, workers or environment during construction. No design needed, therefore, implementation would be rapid.	Lower level of water service than the other action alternatives. Residents must keep existing water supply systems in service for nondrinking uses. Less protective of public health than the other action alternatives. Bottle delivery system and the water quality are expected to be reliable.
3. City of Galena, Deep Wells	Meets ARARs.	No reduction of mobility, toxicity or volume.	Worker precautions necessary during construction of the distribution system through mining areas. Potential exposure of community due to soil disturbance. Increased stream turbidity possible during stream crossing of pipeline. One year or more required for design and construction.	Very effective, fully protects public health, and is very reliable. Increased use of the Roubidoux aquifer water is not expected to increase the potential for shallow ground water to migrate into the Roubidoux system. Permanent safe drinking water supplied to residents.
4. Rural Water District, Deep Well	Meets ARARs.	No reduction of mobility, toxicity or volume.	Worker precautions necessary during construction of distribution system through mining areas. Potential exposure to community due to soil disturbance. Increased stream turbidity possible during stream crossing of pipeline. One year or more required for design and construction.	Very effective, fully protects public health and is very reliable. Increased use of the deep aquifer water is not expected to increase the potential for shallow ground water to migrate into the Roubidoux system.
5. Shallow Aquifer	Can be designed to meet ARARs.	May have beneficial impact on reduction of acid mine drainage into Short and Shoal Creeks.	Greater potential for exposure to workers and community relative to Alternatives 3, 4 and 6. Increased turbidity possible during stream crossing of pipeline. One year or more required for design and construction.	Very costly treatment system required. Potential for problems with shallow ground water quality and the capability for reliable treatment. Wastes from water treatment would be difficult and costly to handle and dispose and would be considered hazardous. Handling and disposal of water treatment hazardous wastes would cause adverse environmental impacts.
6. Spring River	Can be designed to meet ARARs.	May have limited reduction of mobility, toxicity or volume of contaminants in Spring River.	Worker precautions necessary during construction of distribution system through mined areas. Potential exposure to community due to soil disturbance. Increased stream turbidity possible during stream crossing of pipeline and construction of intake. One or more years required for design and construction.	Very effective and fully protects public health. Water supply and water treatment method are reliable. Water treatment lime sludge requires disposal. Conventional landfill disposal can be accomplished with minimal environmental impact.

TABLE 4 (Continued) - DETAILED EVALUATION OF ALTERNATIVES

Alternative	Permanence	Implementability	Cost	Community and State Acceptance
1. No Action	Not applicable.	Not applicable	Total Present Worth $230,000 Annual O&M $25,000	Community and state desire remediation of the water supply. No action is not consistent with community and state sentiment.
2. Bottle water	Not a permanent solution to protect public health.	Good technical and administrative feasibility. No offsite needs or effects. Existing institutional control of bottled water vending is adequate. Most flexible action alternative.	Total Present Worth $2,500,000 Annual O&M $230,000	Effected community may not be supportive because inconvenient alternative and expensive O&M. State is not supportive of alternative.
3. City of Galena, Deep Wells	Permanent solution for alternative water supply. Not a permanent solution for final site-wide actions.	Good technical feasibility. Requires the cooperation of City of Galena and may require establishment of a RWD. No offsite needs or effects. Existing institutional controls on municipal water supply systems are adequate. Low flexibility for modifying systems after installation.	Total Present Worth $5,300,000 Annual O&M $100,000	Public acceptance is supportive, but varies depending on cost to individuals. Alternative is supported by the state.
4. Rural Water District, Deep Well	Provides for a permanent solution for alternative water supply. Not a permanent solution for final site-wide actions.	Good technical feasibility. Requires establishment of a RWU and/or cooperation of City of Galena. No offsite needs or effects. Existing institutional controls on public water supply systems are adequate. Low flexibility for modifying systems after installation.	Total Present Worth $5,300,000 Annual O&M $100,000	Public acceptance is variable depending on cost to individuals. Alternative probably would be supported by the state if Alternative 3 is not available.
5. Shallow Well	Provides for a permanent solution for alternative water supply, although residue hazardous material will need to be disposed of. Not a permanent solution for site-wide final action.	Questionable technical feasibility. Treatment process will require pilot testing. Requires a RWD and/or cooperation of City of Galena. Offsite hazardous waste disposal required. Existing institutional controls on public water supply and on waste disposal are adequate. Poor flexibility for modifying systems after installation. Shallow well supply may conflict with ground water/surface water remedial measures.	Total Present Worth $8,880,000 Annual O&M $320,000	Community and state acceptance of using poor quality water shallow aquifer as a source may be poor. Community and state acceptance of water treatment wastes management methods may be poor.
6. Spring River	Provides for a permanent solution for the alternative water supply. Not a permanent solution for final site-wide actions.	Good technical feasibility. Requires establishment of a RWU and/or cooperation of City of Galena. Requires offsite lime sludge disposal. Existing institutional controls on public water supply systems are adequate. Low flexibility for modifying systems after installation.	Total Present Worth $7,900,000 Annual O&M $200,000	Community acceptance variable depending on costs to individuals. State not supportive due to high O&M costs.

for cleanup standards for the implementation of the remedial action at the Galena subsite. Since hazardous substances will remain at the subsite after completion of this remedial action operable unit, it was essential to identify ARARs prior to, and in conjunction with, evaluation of the alternatives.

All alternatives that were evaluated can attain all ARARs for the alternative water supply operable unit, with exception of the no-action alternative.

Reduction of Mobility, Toxicity or Volume of Waste

Section 121(b) of CERCLA, as amended, states that remedial actions involving treatment, which permanently and significantly reduce the volume, mobility or toxicity of hazardous materials, are to be preferred over those not involving such treatment. This evaluation criterion relates to the ability of a remedial alternative to control or eliminate risks caused by the mobility, toxicity or volume of a hazardous waste.

Alternatives 1 through 4 would have no direct impact on the mobility, toxicity or volume of hazardous materials on the Galena subsite. Alternative 5 involves the pumping and treatment of the shallow ground water and may have a beneficial impact on acid mine drainage into Short Creek and Shoal Creek. Alternative 5 may reduce the contaminant levels in the ground water which may be an overall benefit to the subsite. Alternative 6 involves treatment of water from the Spring River. Although Alternative 6 may reduce the level of metals in the Spring River slightly, it would have little overall effect on the contaminant levels in the river and would have limited overall effect on the contaminant concentration levels in the ground water.

Short-Term Effectiveness

Short-term effectiveness measures how well an alternative provides protection of the environment, community and workers during construction and the time required for implementation of the remedial action.

Short-term risk to the public health and the environment would remain at current levels for Alternatives 1 and 2. During the construction of the waterlines for the pipeline network, Alternatives 3, 4, 5 and 6, would present greater potential risks to the workers and the community due to the soil disturbance in the mined areas. Stream turbidity may increase in Shoal Creek while constructing a pipeline across the creek in Alternatives 3, 4, 5 and 6. Some disruption of flow and turbidity may be created in Spring River during the construction of the water intake described in Alternative 6.

Alternative 2 may be implemented immediately, while Alternatives 3, 4, 5 and 6 may take a year or more to design and construct. Alternative 1, No Action, has no implementation.

Long-Term Effectiveness

Long-term effectiveness addresses the long-term protection and reliability that an alternative affords. This includes the risk to the community once the remedy is in place, risk to workers during operation and maintenance (O&M), environmental risk due to residual hazardous substances, long-term reliability, O&M requirements, time required to achieve protection and the difficulty in detecting and mitigating problems with the completed remedy.

Alternative 1 would not be effective in protecting public health. The public would continue to use existing wells for their water supply. A few people may, on their own initiative, convert to an alternative water supply. The health of the people who have shallow wells with poor quality water would be at risk. More wells may become contaminated in the future, exposing additional people to contamination. Without continued water quality monitoring, newly contaminated wells would not be readily identified. Alternative 1 would not be effective in protecting the environment.

The quality of the bottled water provided in Alternative 2 would be expected to be good. The level of service would be much less than in the other action alternatives. The existing private shallow aquifer wells would remain in service. Therefore, when more convenient, the shallow ground water may be used for drinking and food preparation. The bottled water delivery system should be reliable; however, poor road conditions and unreliable vendor operations could cause some delayed product deliveries. Long-term O&M would be the responsibility of the property owners. Due to the relatively high monthly cost and inconvenience of handling of the bottled water, property owners may stop the delivery and return to using their private wells for drinking water.

Alternatives 3, 4 and 6 would provide effective protection of public health as soon as the construction and house connections are complete and the system is operational. The water supplied should be of good quality. These alternatives require conventional and well-proven distribution and treatment systems. During routine O&M, workers should not be exposed to the hazardous substances at the subsite. Occasionally, repairs to the pipeline may be needed in the mined areas causing increased potential exposure to workers and the community during those repairs. Alternatives 3 and 4, which would draw water from the deep aquifer, may increase the shallow aquifer-deep aquifer head differential. This is not expected to increase the potential for shallow ground water to migrate into the Roubidoux System.

Alternative 5 may result in greater public health risk than Alternatives 3, 4 and 6. Reliable treatment of the shallow ground water may be difficult. Therefore, the supplied water quality may be of questionable quality. Alternative 5 may have beneficial effects in reducing the amount of mine shaft water and

shallow ground water that discharges into Short Creek and Shoal Creek. Alternative 5 may produce a hazardous material requiring storage, transportation and disposal. Increased environmental risks may be created in the handling and disposal of this material.

Permanence

The criterion of permanence is similar to long-term effectiveness, but with an emphasis on the need for management of treated residuals and untreated wastes. The long-term remediation and permanent remediation of the source material will be addressed in the second operable unit. This operable unit only addresses the alternative water supply.

Alternatives 3, 4 and 6 would provide for a permanent solution for the alternative water supply although continued O&M would be required to provide the water supply. The sludge from Alternative 5 may contain hazardous materials, which would require regulated disposal as a RCRA waste. Therefore, Alternative 5 would have continued O&M of hazardous substances. Alternative 2 would not be permanent because it would not provide full protection for the public health and may be eliminated at any time by the property owner. Alternative 1, No Action, provides no permanence.

Implementability

The implementability criterion measures the technical difficulties, operations, reliability and availability of each alternative. Implementability also involves the administrative feasibility of each alternative.

The implementability criterion does not apply to the no-action alternative since no measures would be taken to provide a water supply. Alternatives 2, 3, 4 and 6 all have good technical feasibility and reliability. The proposed water collection, treatment and distribution methods are all well proven to perform their intended functions. The technical feasibility and reliability of Alternative 5 is questionable. Water treatment to reduce acid mine drainage heavy metals to drinking water standards and disposal of the waste products have not been widely performed and are not well proven processes. The availability of equipment for Alternatives 2, 3, 4, 5 and 6 is not expected to cause any delays.

Alternative 2 would require administration of the process of installing bottled water dispensers in the service area for residences and businesses. The property owners should be responsible for maintaining the communications with the bottle water distributors in order to receive a continuous supply.

Alternatives 3, 4, 5 and 6 would require administrative actions for implementation. These actions are feasible, but would require the cooperation of the water users in all cases and to some some extent the cooperation of the City of Galena.

Alternative 3 would require cooperation with the City of Galena to rehabilitate its wells and to deliver water to the city limits. The City may sponsor and operate the complete new service area distribution systems. If the City does not sponsor and operate the complete project, then the formation or expansion of a rural water district may be required. In either case, public support of the project would be necessary to expand the City of Galena's service area or form a rural water district. Alternatives 4, 5 and 6 also would require a rural water district or Galena to operate the system. As in Alternative 3, public support would be necessary to establish the district or to expand the City of Galena service area. These three alternatives also would include having the City of Galena supply water to the north and south service areas adjacent to the City. If the City does not agree to supply these areas, then the project facilities would have to be extended, at additional cost, to serve these areas.

Only Alternatives 5 and 6 would require offsite disposal facilities. Alternative 5 may require a landfill approved for handling EP toxic materials generated by the treatment process. Such wastes should be shipped offsite to an approved RCRA facility for disposal. Alternative 6 would require a conventional offsite sanitary landfill for disposal of the lime sludge generated in treatment of the surface water.

The State of Kansas would require the distribution of the water as described in Alternatives 3, 4, 5 and 6 to operate under a state-issued permit for public water supply systems. Any rural water district formed under Alternatives 3, 4, 5 or 6 would have to meet the state rules and regulations for formation of such a district.

Cost

The cost criterion compares the cost of the alternatives with the overall effectiveness and implementability. The costs include development and construction costs, equipment, land and site development, buildings and services, relocation, disposal, engineerings, legal fees and contingency allowances. The cost criterion also includes O&M costs, including operating labor, maintenance materials and labor, energy requirements, administrative costs, contingency expenses, and insurance, taxing and licensing costs.

The 30-year present worth costs and annual O&M cost of each alternative is presented on Table 4. Alternative 1 costs and a portion of the Alternative 2 costs include operation and maintenance of existing wells. Long-term monitoring of wells was considered for Alternative 1, although is not included in the cost figures cited.

Community and State Acceptance

Tnis criterion reviews community and state acceptance of the alternatives. Comparison and review of supporting and opposing ideas are made to evaluate acceptance of the remedial action. Also, since federal law requires the State of Kansas to provide assurance of the funding of 10 percent of the

remedial action, the acceptance criterion requires a review of the state's ability to provide the required funds.

The comments received indicate that the public would not accept the no-action alternative. Many residents understand the potential health risks associated with drinking contaminated water and also are concerned about the metals presenting taste, odor and color problems.

It is anticipated that the citizens benefiting from the remedial action will be responsible for the 10 percent funds and the long-term O&M of the action. It was anticipated based on discussions with KDHE that any alternative with high O&M costs would not be supported by the community. Alternative 2 has the lowest capital costs other than the no-action alternative and also has the highest O&M cost. Therefore, it is expected to be opposed by the public as a long-term solution. Public acceptance of Alternatives 3, 4 and 6 was expected to be high because these alternatives provide a reliable supply of good quality water.

It was expected that the public may be wary of accepting the treated shallow ground water that would be provided in Alternative 5. Also, handling and disposing of wastes from the shallow ground water treatment may be generally unacceptable to the public, especially those located near transportation routes and the disposal site.

SELECTED REMEDY

General Description

Alternative 3 is the selected remedial action for provision of an alternative water supply for residents utilizing private water wells, which currently supply water from the contaminated shallow ground water aquifer. Alternative 3 utilizes the City of Galena's deep aquifer wells, which supply reliable good quality water. Distribution of the water will be accomplished through a pipeline network to be constructed that will reach all homes, farms and businesses in the subsite.

The City of Galena's existing wells numbers one and two will be rehabilitated to provide additional capacity for the expanded system. The rehabilitation work includes: 1) Replacement of upper well casing, 2) Replacement of pumps for higher pumping capacity, 3) Upgrading the wellhead facilities and 4) Addition of chlorination facilities. If rehabilitation becomes infeasible due to unforeseen onsite technicalities, a new deep aquifer well may be drilled to provide additional water. Existing pipelines within the current municipal distribution system may be repaired or upgraded to facilitate additional flow capacity.

A new pipeline network will be constructed to supply the additional service areas, which include the West, Lowell, North and South service areas as shown on Figure 2. Each of the estimated 418 houses, businesses and farms in these areas will be connected to the water distribution system. Flow valves will be installed for each residence and business and at the Galena distribution area boundaries. A water storage tank will be installed in the West service area. The existing wells will be disconnected from the houses and businesses. If agreeable to the property owners, the wells will be plugged.

The selected remedy includes the purchase and construction of all equipment and facilities needed to operate and maintain the alternative water system collection, treatment and distribution.

The wells, chlorination system and distribution within the City of Galena will be operated and maintained by the City of Galena. The water distribution system outside of the City of Galena will be operated by an entity to be selected by the citizens in the service areas outside of Galena. This entity may be the City of Galena, a newly formed rural water district or an expanded existing rural water district.

Scope and Function of Operable Unit

The Alternative Water Supply Operable Unit in the Galena subsite is the first of several operable units on the Cherokee County site. CERCLA Section 118, as amended by SARA, requires the EPA to give high priority to response actions involving the release of hazardous substances into the environment that resulted in the closing of drinking water wells or has contaminated a principal drinking water supply. Therefore, the alternative water supply operable unit has been conducted prior to other operable units for the Cherokee County site.

The purpose of this operable unit is to provide suitable drinking water to the current population within the subsite. Suitable drinking water is water that meets the primary MCLs. Residences and businesses within the City of Galena obtain their water from the public water supply, which already provides suitable water. The population outside of Galena obtain their water supply from the shallow aquifer and are at risk of using water exceeding the MCLs. A second goal of the remedial action is to protect the deep aquifer from contamination that may occur as a result of implementing an alternative water supply.

A second operable unit in the Galena subsite will address the remediation of the contaminated ground water and surface water. The other subsites will be addressed as separate operable units.

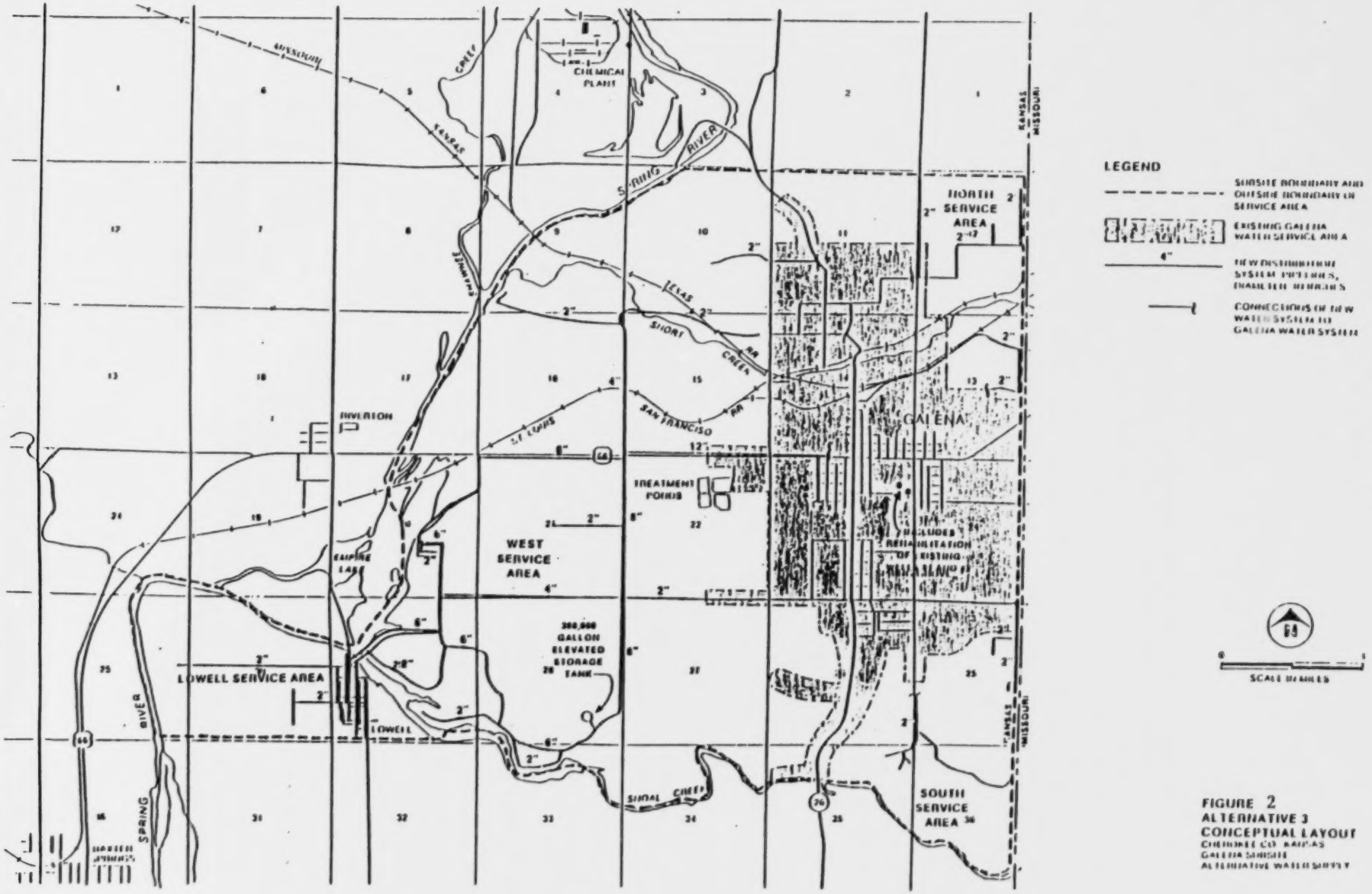

FIGURE 2
ALTERNATIVE 3
CONCEPTUAL LAYOUT
CHEROKEE CO. KANSAS
GALENA SUBSITE
ALTERNATIVE WATER SUPPLY

Performance Goals

Since the selected remedial action will operate as a public water supply, the water must meet the primary MCLs as established by the Safe Drinking Water Act. The water will be obtained from the Roubidoux aquifer and will need no treatment other than chlorination. The goals of the action will be met as soon as the system is constructed and on-line, i.e., the action is protective immediately upon implementation. All ARARs for the remedial action will be obtainable. The ARARs are listed on Table 5.

Rationale for Preference

The selected remedial action is preferred over all other alternatives because it is the lowest cost alternative that provides the greatest protection to the public health. Water collected from the Roubidoux aquifer is of good quality and meets the primary MCLs. Therefore, treatment is unnecessary, which makes the selected alternative more effective and implementable than Alternatives 5 and 6. Alternative 2 may be a protective remedy, but due to potential interrupted service, it is not be as effective or implementable as the selected remedial action. Alternative 3, the selected remedial action, is superior to Alternative 4, which may be just as protective and effective, because of administrative considerations. The City of Galena is a well established entity and is very capable of maintaining a good supply of water. The selected action utilizes the City's experience in supplying water, while Alternative 4 does not take advantage of this experience.

The costs of the selected remedial action are lower than Alternatives 5 and 6 and are approximately the same as Alternative 4. Alternative 2 has a lower present worth, although the annual O&M is unacceptably higher.

All alternatives except no action meet ARARs, so this was not a determining factor. Although Alternatives 5 and 6 may reduce the mobility, toxicity and volume of the contaminants, such reductions were not a goal for this operable unit, but will be important in the second operable unit. The short-term effectiveness of the selected remedial action and Alternatives 4, 5 and 6 is comparable. Since there is no construction in Alternative 2, its short-term effectiveness may be higher. The selected remedial action as well as Alternatives 4, 5 and 6 provide a permanent solution for an alternative water supply.

TABLE 5 - ARARs FOR SELECTED ALTERNATIVE

Chemical/Location/Action	Requirement	Citation	Applicable or Relevant and Appropriate
Treatment of water for public supplies.	Water distributed by a public water supply must meet the SDWA primary MCLs at the tap.	40 CFR §141 KAR 28-15-13,-14,-19	Applicable
Waters of the US	Regulates discharge of dredge and fill material into navigable waters of US	33 CFR §323 40 CFR §230 and §231 §404 CWA	Relevant and appropriate for pipeline stream crossing.*
Ground water source for public water supply.	Controls well location, spacing, water use, aquifer depletion and appropriations.	Kansas Ground Water Management District Act; Kansas Water Appropriation Act.	Relevant and appropriate.*
Installation of public water supply well.	Regulates construction, reconstruction, treatment and plugging of water well.	Kansas Administrative Regulation 28-30-1 to 28-30-10.	Relevant and appropriate if well is drilled or if wells are plugged.*
Permit for public water supplies.	Standards define treatment requirements for public water supply systems.	Kansas Administrative Regulations 28-15-16.	Relevant and appropriate.*
Design and operation of public water supply systems.	Standards define design requirements and acceptable operation practices for public water supply systems.	Kansas Administrative Regulations 28-15-11 and 28-15-14 through -20. Design policies in Kansas Bulletin B-1-15 (1984).	Applicable
Establish rural water district or rural water supply district.	Establishes procedures to create a rural water district or rural water supply district.	Kansas Statutes Annotated, 82a-601 through 645.	Applicable if RWD established.
Expansion or improvement of public utilities by a city.	Rules govern the expansion of utilities by city governments.	Kansas Statutes Annotated, 12-861, 862 and 863; 12-820 and 821; and 12-674 and 693.	Applicable if city distributes water.

*Permit not required for CERCLA onsite projects, therefore not applicable.

COMMUNITY RELATIONS RESPONSIVENESS SUMMARY
CHEROKEE COUNTY SITE - GALENA SUBSITE
CHEROKEE COUNTY, KANSAS

The U.S. Environmental Protection Agency (EPA) completed an operable unit feasibility study (OUFS) to examine different methods for providing an alternative water supply for the residents of the Galena subsite of the Cherokee County Superfund site. The Cherokee County site has been listed on the National Priorities List (NPL) for cleanup of Superfund sites. The EPA and the Kansas Department of Health and Environment (KDHE) developed a proposed plan for an alternative water supply based on the results of the OUFS. A fact sheet and the "Proposed Plan" outlining the proposed remedial action was sent to about 300 interested persons in October 1987.

On November 4, 1987, a public meeting was held in Galena, Kansas, to present the results of the OUFS and the proposed remedial action. Approximately 100 people attended the meeting. Representatives of EPA, KDHE and the City of Galena presented the proposed remedial action to the public. The OUFS report and the Proposed Plan were distributed at the meeting. The EPA also announced that a 30-day public comment period was open from November 4 to December 4, 1987. Following a request that the comment period be extended, the 30-day period was extended by EPA an additional seven days to December 11, 1987. Significant oral comments from the meeting and written comments received prior to and during the 37-day comment period have been considered and responded to herein this summary. Responses to the comments are provided in the following summary. During the comment period, eleven comment letters were received from the general public and one comment letter was received from seven potentially responsible parties (PRPs). During the public meeting on November 4, approximately ten people made verbal comments. At a meeting held with the PRPs, approximately six commenters made verbal comments.

I. General Response to Significant Comments

In general, public comments have been favorable of and support implementation of the proposed plan for an alternative water supply to the residents of the subsite. One significant concern, raised by several commenters, deals with the 10 percent matching funds that the State of Kansas must provide assurance of for the remedial action. According to federal law, EPA will provide 90 percent of the funding for the remedial action provided the State agrees to pay or provides assurance of payment for the remaining 10 percent. The KDHE has indicated that the local residents, who benefit from the remedial action, should provide the 10 percent matching funds. Several commenters suggested that the local residents may not be capable of providing these funds.

The EPA believes these comments were based on past efforts of these residents to obtain funding for the establishment of a rural water supply district. Such efforts failed because the residents needed to supply 100 percent of the capital costs for the water supply district. The EPA believes that because the federal government will fund 90 percent of the capital costs for the water supply system, these residents will be capable of providing the remaining 10 percent. The KDHE also believes that funding can be provided by these residents.

In general, comments from the PRPs have been in opposition of the proposed remedial action. One of the most significant concerns raised by several PRPs deals with the necessity for supplying all residents within the subsite, who obtain their water from the shallow ground water, with an alternative water supply. The commenters suggest that only about 10 percent of these residences need an alternative water supply because EPA's investigations demonstrate that about 10 percent of these residences have known contamination in their private water wells.

Although EPA's investigations demonstrate that only about 10 percent of these private wells are currently exceeding maximum contaminant levels (MCLs), the investigations also show that the contamination migrates through the shallow ground water within the subsite. This migration of the contaminants threatens all the private wells in the shallow ground water aquifer. Investigations at the subsite demonstrate that migration occurs depending on various factors, e.g., well pumping rates, annual precipitation, surface water infiltration rates, seasonal variations and fractures within the formations containing the shallow ground water. In addition, investigations have shown that the water quality of a given well varies in time, e.g., one sample exceeding primary MCLs and the next sample taken a week later from the same well falling below MCLs. The EPA believes that all private wells obtaining water from this contaminated shallow aquifer are either currently contaminated with hazardous substances or substantially threatened with such contamination.

II. Specific Comments From General Public

Comment: Several commenters suggested the local residents would not be able to provide the 10 percent matching funds. Some commenters noted that several years ago, a group of Lowell residents tried to form a rural water supply district for water supply and distribution, however, they were unable to obtain necessary funding.

Response: The Comprehensive Environmental Response, Compensation and Liability Act of 1980 (CERCLA), as amended, requires the affected state to provide assurance of the funding for 10 percent of the cost of a remedial action funded through the federal Superfund. The KDHE has stated that the 10 percent cost share for the alternative water supply operable unit should come from the people who would benefit from the remedial action. The capital cost per household is approximately $1,000 provided all 418 households participate. The monthly cost for water use is approximately $20 per household. Since EPA provides 90 percent of the funding, it is likely that these residents will be able to obtain the necessary 10 percent funds. In addition, loans may be available from the Farmers Home Administrative (FHA) for assisting a community organization with the 10 percent cost share. That community organization would need to discuss this with FHA.

Comment: Several commenters suggested that the City of Galena would benefit from the action, but may not be required to pay any portion of the 10 percent matching funds.

Response: The EPA cannot specify how the responsibility for providing the 10 percent matching funds should be distributed among those who benefit from the remedial action. The State of Kansas has placed this responsibility upon the local community. The City of Galena would indirectly benefit from the remedial action because the City's wells may be rehabilitated and some city water pipelines may be repaired or upgraded if necessary to accommodate increased flow capacity.

Comment: Several commenters stated they thought the affected people would prefer the formation of a rural water district, as in Alternative 4 of the OUFS, as opposed to the City of Galena providing the water. A couple of commenters stated that the water lines in Galena are old and could have problems. They did not want to pay for the upkeep of an old system when a totally new system could be constructed and would have lower costs for upkeep. Another commenter was concerned about the City of Galena setting the rate structure for the rural area.

Response: The EPA recognizes these concerns. The Agency selected this action over Alternative 4 because the City of Galena is experienced in maintaining a public water supply system. Also, the City has trained staff for the operation and maintenance (O&M) of the system. The EPA believes using the existing deep wells in the City of Galena is the best use of available resources for implementation of this remedial action.

Comment: A couple of commenters questioned why EPA did not examine the food intake contaminant pathway in the OUFS.

Response: The additional exposure to the contaminants through intake of foods (crops and fish) raised onsite is a minor pathway. Exposure by ingestion of the contaminants through water is a much more substantial pathway, therefore, EPA did not quantify the food source pathway. During the remedial investigation, fish were collected and analyzed. The levels of metals in the fish were similar to levels in fish found state-wide.

Comment: A couple of commenters recommended that bottled water be provided to the homes in the affected area until the remedial action is in place. One commenter provided literature on a water treatment system for removing heavy metals.

Response: The EPA does provide interim remedies in cases where there is an immediate threat to human health. The EPA has used this authority to provide individual water treatment units for private wells within this subsite where the human health threat has been immediate. The levels of contaminants in most of the private wells in the subsite are at levels which do not represent an immediate threat. The major health risk at the subsite is due to long-term exposure to the contaminants, therefore, an interim remedy would not be appropriate.

Comment: One commenter stated that there are additional costs of the no-action alternative that were not discussed in the OUFS. He suggested EPA address the health costs associated with the detrimental health implications of the no-action alternative.

Response: Although additional health-related costs may be incurred if the no-action alternative was implemented, such costs are technically impractical for EPA to estimate.

Comment: A commenter suggested EPA post signs around the subsite warning of the physical dangers associated with the chat piles and open mine shafts.

Response: Such problems are beyond the jurisdictional powers of the EPA. However, these problems have been addressed in part by the U.S. Bureau of Mines. The Bureau conducted an investigation of safety hazards and conducted followup activities to correct those areas presenting the greatest safety hazards to the general public.

Comment: One commenter suggested that the EPA conduct long-term health screening on the residents of the subsite to determine if the remedial action actually improves the health of the local population.

Response: The EPA has limited funding to cleanup Superfund sites across the United States. The Agency must carefully determine the best use of these funds. As a result of the OUFS, EPA believes this remedial action is appropriate for the protection of the public health at this subsite. The alternative water supply should reduce the exposure of the public to the contaminants, thereby reducing the public health risks at the subsite. Federal, State or local health agencies are the appropriate government entities to conduct followup health studies on the population of concern.

Comment: A couple of commenters thought the distribution lines should be extended further. One suggested that the area west of Lowell and east of the Spring River should be included. Another suggested that Sections 1 and 2 above the north service area should be included.

Response: The EPA intended to include all houses west of Lowell and east of the Spring River in the distribution system. Sections 1 and 2 north of the north service area were left out of the distribution service area because they are thought to be outside of the area affected by mining activities. Those areas and other areas could be included when the distribution system is developed, although EPA cannot pay 90 percent of the costs. Another commenter stated that his well, located outside of the subsite, was sampled. The EPA sampled wells site-wide and only detected problem wells in the Galena subsite.

III. Specific Comments From PRPs

Comments were received from a group of companies that comprise the majority of the identified PRPs of this subsite. The following discusses various significant comments from this group and provides EPA's response.

Comment: The PRPs suggested that mining activities are not the sole source of contamination and that natural mineralization contributes to the problem.

Response: In 1983 the Cherokee County site was placed on the National Priorities List because of a known release of hazardous substances into the environment and because of the substantial threat of continuing releases of hazardous substances. The EPA contends that the source of the release is the abandoned mining facilities, which currently exist at the site and consist of mine waste piles, open mine shafts, underground mining caverns and smelting wastes among other wastes. Although the remaining undisturbed ore body may contribute to the release of hazardous substances, the abandoned mine workings and wastes provide the major portion, if not all, of the hazardous substances released and threatened to be released into the subsite environment. The mining activities altered the existing ore body, which caused the mine wastes and remaining in situ ore to be exposed to oxygenated water and air, which in turn caused the direct release of hazardous substances into the shallow ground water at the subsite. This exposure causes the production of acid mine drainage, which in turn mobilizes the heavy metals and causes the release of heavy metals into the ground water. In addition, mining activities may have increased the fractures in the rock formations that contain the shallow ground water. This allows an increased mobility of the ground water, hence an increased migration of the acid mine drainage and the spread of heavy metal contamination throughout the shallow ground water aquifer. Under the authority of the Comprehensive Environmental Response, Compensation and Liability Act of 1980, as amended, EPA has the authority to respond to releases or the threat of releases of hazardous substances into the environment.

Comment: The PRP commenters suggested that the area impacted by the mining activities is much smaller than the subsite boundaries as defined by EPA. The commenters stated that the area actually mined was about 246 acres within the 18 square mile area encompassed by the subsite boundaries. The PRPs disagree with EPA's inclusion of the entire 18 square miles in the subsite boundaries. The PRPs allege that areas outside of the immediate mined areas are not affected by acid mine drainage. The PRPs support their contentions by citing a U.S. Geological Survey (USGS) report. The report, by Timothy Spruill of the USGS, stated that within the Galena subsite no conclusive evidence exists that demonstrates the lateral migration of the shallow ground water.

Response: The EPA acknowledges that the abandoned mining facilities cover only a small portion of the entire Galena subsite (approximately 20 to

30 percent). Nevertheless, EPA believes that the entire subsite is affected by the subsequent lateral migration of the contaminated ground water. The EPA's investigations at the subsite support our contentions. Random sampling of wells located outside of the immediate mined areas has shown several wells to contain metals exceeding the MCLs. These wells obtain their water from the shallow aquifer contained in fractured limestone formations. These limestone formations are the same formations where the underground mines are located. The EPA believes that natural flow gradients and artificial gradients, created by pumping of wells, has caused migration of the contaminated ground water within the subsite boundaries. The acid mine drainage flowing through natural and man-made fractures in the limestone formation may expand the fractures by dissolving the limestone, thus increasing the flow of contaminated ground water.

The residents of the subsite, who are not currently connected to the City of Galena's public water supply system, are dependent on the shallow aquifer for their drinking water. Since the residents use wells that are located in the same formations as the mines, and the mines currently contain ground water with the highest levels of heavy metals found at the subsite, the EPA believes that all of these private wells are threatened by migration of the contaminated ground water.

The EPA acknowledges that because of the complex hydrogeology of the site, it is not possible with the current data to define in detail the ground water flow paths. The EPA considered investigating the subsite further to define the detailed pathways, but determined that because of the large cost of such a project with no guarantee of a conclusive answer, the limited funds in the Superfund would be better spent addressing the threat. The USGS report referenced by the commenter was prepared before EPA sampled and analyzed water from an additional 133 wells in the subsite. The author of the USGS report has informed EPA that with the limited data utilized in his report, no conclusive statement could be made regarding the lateral migration of the ground water. Even with the additional data, EPA and the USGS could not conclusively state that the acid mine drainage will migrate to each well in the subsite. However, the current understanding of the hydrogeological conditions of the subsite indicates that lateral migration is occuring and it is only a matter of time before each well at the subsite may be contaminated from the acid mine drainage containing the heavy metals.

Comment: Several PRPs commented on the adequacy of the sampling program and resulting data. They stated that no data were available to reach some of the conclusions EPA made in the OUFS report.

Response: The EPA does have adequate data to support all the conclusions made in the OUFS report. The procedures used in the investigations provided excellent information for the feasibility study. The actual data were not contained in the OUFS report, but are available in the administrative record located in Galena and in Kansas City. The EPA believes the commenters will be satisfied if they review the administrative record.

The administrative record includes results of various EPA investigations of the subsite. During 1985-86, EPA conducted two phases of sampling of private wells in the immediate area around the City of Galena. Twenty-five percent at the wells were sampled in the first round. The second sampling episode was conducted because several wells were found to contain metals exceeding the MCLs. During the second round, the EPA attempted to locate and sample the remaining 75 percent of the wells in the immediate area to identify additional wells with concentrations of metals exceeding MCLs. In 1987, the EPA expanded the area of investigation because locations southwest of Galena were suspected to be affected by migration of the contaminants. The 1987 investigation attempted to locate and sample 25 percent of the wells in that area to obtain an indication of whether or not the problem extended into those areas.

Of the 72 wells sampled in the immediate City of Galena area, about 7 percent exceeded the primary MCLs, 18 percent exceeded maximum contaminant level goals (MCLG) and 14 percent exceeded health-based criteria established in the Clean Water Act (CWA). Of the 49 wells sampled in the second area, 8 percent exceeded MCLs, 10 percent exceeded MCLGs and 18 percent exceeded CWA criteria.

During 1987, a few wells were sampled three times and were found to vary in the water quality. This variability is most likely due to changes in pumping rates throughout the aquifer or precipitation variability. One commenter suggested that the variable could be in the field or laboratory techniques as opposed to variations within the aquifer. The EPA believes that field and laboratory techniques utilized in this investigation were most accurate. The EPA believes that the data indicate the water quality to be quite variable; therefore, the one-time sampling of many wells may not provide representative results of the long-term quality of the water. More wells may actually exceed MCLs than indicated in the results.

Comment: Several PRPs comments pertained to the selection of other available alternatives as opposed to the selected alternative. The commenters were under the impression that EPA believed that all the wells in the subsite were currently contaminated and pointed out that only 10 percent exceeded the MCLs as opposed to 100 percent. The commenters suggested that the selected remedial action should be confined to only the currently contaminated wells with periodic monitoring of the remaining wells. They pointed out that EPA has already provided individual water treatment units on several of the contaminated private wells.

Response: The EPA is including the whole subsite in the remedial action. Several wells are currently contaminated and all the others are at risk because of the threat of the migration of the contaminants to all wells. The EPA initially considered supplying bottled water to only those households with contaminated water wells and monitoring the remaining wells, although this consideration was not included in the OUFS. The cost estimates of the proposed remedial action and the bottled water with monitoring alternative action were the same, yet the proposed action is much more protective of human health.

As the commenters pointed out, EPA has supplied individual water treatment units to several wells, however they cannot be provided to all wells as a long-term remedy, only the wells of immediate health risk require this type of temporary response action. The individual water treatment units require monthly maintenance in order for them to remove the contaminants and periodic sampling to monitor their effectiveness. Residents on sodium-restricted diets should not drink water treated by these units because they add a large amount of sodium to the water. Because of these problems, the units are considered only to be temporary. The overall remedy requires a permanent solution.

Comment: The PRPs suggested that the alternative water supply could be provided by bottled water delivery as analyzed in Alternative 2 of the OUFS report. They stated that it is protective of public health, meets applicable and relevant or appropriate requirements (ARARs), provides a reliable supply of water and has good technical feasibility. They stated it was superior to the selected remedy because it would have no potential indirect environmental effects, would require less institutional and administrative activities to implement, would be more flexible and could be implemented more quickly.

Response: The EPA acknowledges that the bottled water alternative has many good points, however Alternative 3 of the OUFS was selected for several reasons that make it superior to Alternative 2. The public water distribution system is much more protective of public health because all indoor water taps will provide good quality water, not just the bottled water taps. Residents would be dependent on indefinite delivery times for the bottled water alternative, while the public supply will be constant.

Federal law requires EPA to consider long-term operation and maintenance costs in selecting remedial actions. This is a very important consideration for Alternative 2 because the O&M per household is expected to be $46 per month as opposed to $20 per month for Alternative 3, the selected remedy. The commenters stated that Alternative 3 could cause an indirect environmental effect on the deep aquifer due to increased pumping. A preliminary review of data collected during the summer of 1987 indicates no negative effects from the additional pumping of the deep aquifer. Although a review of the preliminary determination will be conducted prior to implementation of the selected remedy. The review is expected to confirm that no adverse affects will result from the increased pumping.